IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the Application of Entwistle, et al.	) Examiner: John K. Fristoe, Jr.
for VALVE ARRANGEMENT	) Group Art Unit: 3753
	) Confirmation No.: 7090
Serial No.: 10/573,873	) Our Docket No.: 6495-0155WOUS
Filed: March 29, 2006	)

Mail Stop AMENDMENT
Commissioner for Patents
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INVENTOR'S DECLARATION MADE UNDER 37 CFR § 1.132

Now comes Richard Entwistle, an inventor of the invention claimed in the above-identified application, who declares and states as follows:

1. I, Richard Entwistle, hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the enforceability of the above-identified application, any related application, or any patent issued thereon.
2. In response to the Office Action issued May 20, 2008, in response to the Final Office Action issued September 8, 2009, in response to the Advisory Action issued December 30, 2008, in response to the Examiner's Answer

issued September 15, 2009, and further in response to the contentions repeatedly stated therein that Tan (U.S. Pat. No. 5,687,759) "inherently" provides a suction nozzle, I state the following:

3. **Qualifications.** I am an expert in the field of fluid systems, with a particular expertise in controlling flows of fluids as by valves and the like. Danfoss A/S has employed me since 1980 as a researcher and inventor in this field. I began my work in this field in 1980 after receiving my MSC degree from Cranfield Institut of Technology. I have helped to develop many commercial products, including several valve model numbers for Danfoss A/S.

4. **Tan (U.S. Pat. No. 5,687,759).** Tan discloses a fast-response servovalve 10 having a primary fluid passage, a primary valve 18 for metering flow through the primary fluid passage, and a pilot valve 20 for controlling operation of the primary valve 18. These items are described in Tan's column 3, lines 41-48, and are shown in Tan's Figure 2.

Tan's primary valve 18 includes an inlet 14, an outlet 16, a partition 22 dividing the inlet and the outlet, and an opening 24 formed through the partition from the inlet to the outlet. The opening 24 can be closed by a plug 60, which is mounted on a stem 62. The stem 62 also carries a diaphragm 64, which partitions a control chamber 32 from an inlet chamber 26 formed adjacent to the inlet 14. A spring 66 pushes down on the diaphragm 64 and on the stem 62 to seat the plug 60 into an opening 24. The inlet chamber 26 is directly connected to the inlet 14 of the primary valve 18. The control chamber 32 is provided with a slow continuous supply of fluid from Tan's inlet 14 via a pilot inlet passage 48 formed through a wall of the inlet chamber 26. The control chamber 32 can be vented to the outlet 16 of the primary valve 18 via a conduit 56.

Tan's pilot valve 20 is installed in the conduit 56 between the control chamber 32 and the outlet 16. Tan's pilot valve 20 includes a plug 38 having a restricted orifice 40. The plug 38 is installed into a threaded opening 36 formed in Tan's valve casing 12 adjacent to the outlet 16. The restricted orifice 40 acts as the seat of Tan's pilot valve 20, and receives a control plug 82 for closing the pilot valve 20.

When closed, Tan's pilot valve 20 blocks flow through the conduit 56. Thus, when the pilot valve 20 is closed, the slow continuous supply of fluid to Tan's control chamber 32 through the pilot inlet passage 48 equalizes pressure across the diaphragm 64. Thus, when the pilot valve 20 is closed, the spring 66 can push the diaphragm 64 downward to shut the primary valve 18.

When opened, Tan's pilot valve 20 vents the control chamber 32 to the outlet 16 through the conduit 56. Venting the control chamber 32 causes a pressure difference across the diaphragm 64. The pressure difference overcomes the force of the spring 66, and causes the diaphragm 64 to move into the control chamber 32, thereby opening the primary valve 18. The slow continuous supply of fluid through the pilot inlet passage 48 always maintains the control chamber 32 at slightly higher pressure than the outlet 16, so to keep the primary valve 18 opened, Tan's pilot valve 20 must be kept open so Tan's throttle 48 can not re-pressurize the control chamber 32.

5. **Similarity of Tan to Acknowledged Prior Art.** In my expert opinion, Tan's servovalve is exemplary of the prior art servovalves discussed in paragraphs 3 through 5 of the written description in my above-identified patent application. Typically, such valves are designed to minimize pressure drop through the primary valve opening when the primary valve is opened.

6. **Performance of Prior Art Valves Similar to Tan's Valve.** Based on my professional experience with similar valves, I am able to form an expert

opinion regarding the predictable behavior of any valve substantially similar to Tan's servovalve.

My expert opinion is that, when installed in a fluid system where an INLET pressure is present in the primary valve inlet chamber, a servovalve similar to Tan's servovalve will open when an OPENING pressure is present in the primary valve control chamber, so that the downward spring force and the OPENING pressure against the diaphragm together are not sufficient to overcome the upward INLET pressure against the diaphragm.

When installed in a fluid system where a downstream flow resistance is present at the primary valve outlet, a valve substantially similar to Tan's servovalve generally will start to open quickly, and then will continue to open less quickly. Additionally, a valve substantially similar to Tan's servovalve predictably will exhibit periodic "chatter", or vertical oscillations, of the control diaphragm and the primary valve plug during flow through the primary valve opening, as discussed in paragraphs 22-31 of the written description in my above-identified patent application.

7. **Invention**. As described in paragraphs 7-17 and 32-39 of my above-identified patent application, my co-inventor and I discovered that the slow opening performance and the vertical oscillations of prior art servovalves are caused by pressure build-up at the pilot valve outlet. The pressure build-up at the pilot-valve outlet occurs because the pilot-valve outlet is disposed at a region of near-zero fluid velocity in the outlet of the primary valve, so that during flow through the primary valve, the downstream flow resistance causes static pressure at the pilot-valve outlet to approach or exceed static pressure within the primary valve control chamber. Accordingly, we discovered that valve chatter could be reduced, and that opening of a primary valve could be made more uniformly rapid, by venting a primary valve control chamber through a pilot valve suction

nozzle arrangement that positions the pilot valve outlet in a region of reduced dynamic pressure within a fluid flow path.

In one embodiment of the invention, the suction nozzle arrangement extends the pilot valve outlet from the wall of the primary valve outlet (a boundary region with low or zero velocity, into an area of a diameter of the primary valve outlet (a flow region with higher velocity). Although the suction nozzle arrangement somewhat increases flow resistance through the pilot valve and through the primary valve, the substantially diminished fluid dynamic pressure at the suction nozzle outlet more than compensates for the increased flow resistance, assuring that even during an OUTLET FLOW pressure condition, venting flow from the primary valve control chamber will be continued to keep Pcc less than OPENING pressure.

8. **Non-Obviousness of the Invention**. In my expert opinion, the invention described above, and in my above-identified patent application, was not an obvious modification of the prior art valves exemplified by Tan. In particular, the prior art approaches of reducing downstream flow resistance, and/or reducing pilot valve flow resistance, did not teach or suggest modifying the pilot valve structure to provide a region of lower fluid dynamic pressure at the pilot valve outlet. Thus, the prior art as a whole did not teach or suggest modifying a valve arrangement to include a suction nozzle arrangement located in the flow path of the valve arrangement, as presently recited by claim 1 of my above-identified patent application. If anything, the prior art approach of reducing pilot valve flow resistance *taught away* from extending a pilot valve structure into the flow path of a primary valve, a modification which predictably would increase pilot valve flow resistance.

With reference to the pending rejections, Tan (U.S. Pat. No. 5,687,759) or Kubiak (U.S. Pat. No. 4,025,045), individually, or the combination thereof,

does not teach or suggest that a pilot valve outlet should be modified to include a suction nozzle arrangement, nor that such a modification could overcome the well known problem of primary valve chatter. In particular, Tan does not teach or suggest that valve chatter is a problem to be solved. Tan also does not teach or suggest a suction nozzle arrangement, since (during flow through Tan's primary valve opening 24) Tan's pilot valve orifice 40 opens onto a region of near-zero fluid velocity in the outlet 16 of Tan's primary valve 10. Kubiak similarly fails to teach or suggest that valve chatter is a problem, or that a suction nozzle arrangement should be provided.

Respectfully submitted by

[Declarant's name]

Dated

10/11/09.